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14. See Hasson, 2008, figure 4.

15. Speer et al, 2009; Hasson et al, 2008. Hasson has also found systematic differences in ISC between different genres, e.g., a continuum from high to moderate ISC for Hitchcock suspense thrillers, Spaghetti Westerns, and contemporary sitcom comedies respectively.

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Where There Be Dragons: Finding the Edges of Neuroaesthetics

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Neuroaesthetics is just starting to be mapped. Its territories and boundaries are not well defined. In these early days, you might ask why philosophers should care about what neuroscientists have to say about aesthetics. Let me ask the complementary question. Why should neuroscientists care about what philosophers have to say about neuaroaesthetics? The answer to this question is pretty standard fare. Stuck in the mess and mire of incremental science, most neuroscientists do not have the time or the training to step back and take a broad view of what we are doing, even though that might be precisely what is needed in these early days. We ought have a sense of where we are and where we might go. That, after all, is what maps are about. Refining early maps or drawing new ones is where philosophers could be extremely helpful. What is worth knowing better, what is unknown but knowable, and what should we simply pass over?

To date, different kinds of writings get called neurosaethetics. One kind of writing, which I have referred to as parallelism, receives a lot of attention. It is a form of speculative science that says that things artists do have parallels in how the brain works.[1] This approach drapes art and aesthetics with neuroscience. Thus, one might propose that artists during the early twentieth century were dissecting their visual world and in the process "discovered" modules that neuroscientists later found in the visual brain. Or one might point out that artists paint in a way that better fits our mental representation of objects rather than the physics of light, shadow and color of the object's physical presence in the world. Or one might make sweeping claims about perceptual principles that are used by artists to "explain" aesthetic experiences. Regardless of the merits of these claims, which would need to be evaluated individually, let us be clear about one thing. Speculative science trades on neuroscience, but isn't doing neuroscience. By that I mean it does not articulate clear theoretical frameworks, propose testable hypotheses or design experiments. Conjecture is often presented as conclusion. When philosophers bother

with neuroaesthetics, unfortunately, speculative science is often what they are bothered by.[2] I suggest that philosophers turn their attention to experimental neuaroaesthetics, perhaps by looking at the recent edited volume by Skov and Vartanian[3] or recent reviews[4] including (self-servingly) one that I wrote. This is where conceptual clean up by philosophers could be useful.

As an experimental science, neuroaesthetics starts with a critical core of sensations, emotions and semantics. Each of these domains can be studied to varying degrees in isolation or in combination or in the context of an aesthetic experience. Note that this basic core applies to natural scenes, to the design of artifacts, as well as to artworks. In other words, this core cuts across aesthetics and art. The connection between sensations and emotions is most amenable to neuroaesthetics inquiry. We can look for stable regularities of light, line, color and form in artwork that are pleasing and relate them to the kinds of neural coding for which our brains seems designed. We can make inferences about the kind of emotions evoked by aesthetic experiences in general and to artwork in particular. Much of the research on aesthetic emotion thus far has been on preferences in a fairly simple way. The focus has been on beauty and whether people like what they see. However, these are starting points in an early research program and nothing in principle restricts neuroscience experiments to a beauty-preference axis. Neuroscience might have something to say about more complex combinations of emotions and reward systems. For example, we are learning more about the psychology and neuroscience of anxiety and that of disgust. Experiments looking at artworks that gain force by creating anxiety or evoking disgust could be designed. One could ask if these typically negative emotions, in an aesthetic context, become pleasurable.

Unlike sensations and emotions, when it comes to semantics in art, we run into the limits of what neuroscience can offer. Current neuroscientific methods are best at examining the biology of our minds for things that are stable and relatively universal. However, if the meaning of an artwork changes over time and relies on interactions with its cultural context and the local prejudices of the viewer, then it will be too slippery for neuroscience. Most neuroscientific approaches to semantics cannot deal with this level of complexity. The bulk of neuroscience work in semantics is at the level of single words and objects. How do we recognize or know a lemon or a lion? There is interest in the semantics of actions and events as structured by verbs and simple sentences. This level of analysis adds complexity by going beyond what things are, to what things do in the world. There is even limited work on discourse and on the brain bases for metaphors. However, these forays into semantics by neuroscience are a far cry from the multi-layered meanings and references that art historians and critics peel away when interpreting art.

Getting back to conceptual cartography. Imagine an early sixteenth-century map of the world. In this map, the contours of Europe and Asia and Northern Africa are pretty well worked out. But, some coastlines and interiors lack detail. Off to the west, there is some sense of a "new world," but even the basic contours of this world are not worked out. Even less accessible is the topography under the oceans. Neuroaesthetics faces an old world, a new world and a sub-oceanic world. The sub-oceanic worlds are realms that we cannot reach with available neuroscience methods. As I alluded to, one of these inaccessible realms is art interpretation as understood through the analysis of cultural and social meanings layered on individual works of art. At the other end, we might have a lot to say about the details of the old world. We might show how the brain segregates encounters with paintings that emphasize color from those that emphasize form, or the way different parts of our visual cortex responds to landscapes as compared to portraits. We might learn more about the reward systems and its connection to emotions as people look at art. This kind of research adds detail to our understanding of aesthetic encounters, but does so within systems on which there is general agreement. For example, it is hard to conceive of a neural system in which landscape paintings would not activate the parahippocampal place area and that facial portraits do not activate the fusiform face area, parts of the brain that respond to photographs of landscapes and faces respectively. Beyond the obvious, there are questions within this old world that are of great interest to neuroscientists, but might not engage folks in the humanities. One such question would be whether visual processing areas evaluate objects in addition to classifying them. Does the fusiform face area also respond to the beauty of faces in addition to classifying them as one kind of object? Work from my lab suggests that these perceptual classification systems might also be evaluating faces.[5] Not everybody reports this finding. Resolving this discrepancy would be of great interest in understanding how the nervous system partitions circuitry dedicated to classifying or to evaluating things. But, understanding the neural organization of this partitioning will not alter the basic idea that we have classification systems and evaluation systems.

A fundamental challenge for neuroaesthetics is understanding new worlds. Can we discover new things about aesthetics? More pointedly, even within experimental aesthetics, can neuroscience methods deliver something beyond what can be learned from behavioral experiments alone? Let me offer one example of the kind of question that comes to mind. We know that if asked whether one likes a painting, knowledge about the painting influences what the person says. However, just from this behavioral observation, it is not clear that the person's emotional experience of the art is altered. They might claim to like the work because they like the knowledge they have of it or because they have learned they should like it. However, preliminary data suggest that this kind of cognitive response is probably not how it works. In a recent imaging study people looked at patterns that they thought were either taken from museums or generated by computers. The participants had greater activity in the medial orbitofrontal cortex for the same images when they were thought to be museum pieces.[6] From the fact that neural activity in a location known to index rewards is modulated by context, we can reasonably infer that information actually changes the emotional experience. This observation tells us something about the nature of the aesthetic experience as affected by knowledge, something that we might not have known strictly through introspection or behavioral observation. While neuroscience is not ready to deal directly with interpreting the complex content of artwork, it can address the effects of knowledge of that content. Admittedly, the knowledge in the experiment I described is one-dimensional compared to the multiple dimensions of knowledge that apply to art interpretation. But, the experiment points the direction that such studies could take. I should be clear that such studies would be directed at how knowledge influences the encounter with a work of art and not the meaning of the work. A fundamental challenge for neuroaesthetics is identifying these kinds of research questions that are relevant, tractable and would potentially reveal new insights into aesthetics.

Perhaps experimental neuroaesthetics is too early in its own evolution and not settled enough to make it worth philosophers stepping in. But, whenever the time is right, now or in the near future, this is the level at which the analytic tools of philosophers could be helpful to neuroscientists. Further discussion of speculative neuroaesthetics does little to advance the field. Some philosophers have dipped into the murky world of experimental neuroaesthetics[7] and I hope more will follow. As we navigate in the haze of this emerging field, it would be nice to be clear when we are scrutinizing old lands and what we might learn from them. It would also be helpful to know when shapes

in the distance are new lands and what new discoveries we might make if we were to land there.

Endnotes

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What Should We Expect from the New Aesthetic Sciences?

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As William Seeley reminds us in his article (this issue), the scientific study of aesthetics can be traced back to the beginning of experimental psychology and the work of Gustav Theodor Fechner in the second half of the nineteenth century. Among other things, Fechner showed that certain abstract forms and proportions are naturally pleasing to our senses. For example, he conducted experiments to show that a rectangle is most pleasing when its side lengths are in the golden ratio of approximately 1:1.618. He argued that the empirical study of aesthetics must proceed from the bottom up, where aesthetic concepts and principles are assembled from individual pieces of objective knowledge. This approach, which he called "aesthetics from below," contrasted sharply with what he called "aesthetics from above" (or philosophical aesthetics) in which knowledge of aesthetic phenomena was derived primarily from conceptual and introspective analysis.

Continuing in Fechner's footsteps, experimental psychologists in the second half of the last century have identified a wide range of factors influencing our aesthetic responses. For example, they have shown that our judgments of aesthetic preference and our feeling of aesthetic pleasure are governed by stimulus symmetry, complexity, novelty, and familiarity, among other factors.[1]

Given the long history of empirical aesthetics, there can be no doubt that this field of study has made a significant contribution to our understanding of at least some aspects of aesthetic response. This contribution extends beyond the early findings that were obtained using simple or ordinary objects (e.g., geometrical shapes and human faces), to recent studies that use artworks as stimuli. But to what extent can empirical studies further understanding of our aesthetic engagement with artworks?

One way of answering this question is to reflect on the goal of aesthetic science. The psychologist Rolf Reber recently suggested that "art theorists… define the criterion of what the [aesthetic] experience is expected to be; scientists… provide a test of whether this criterion is fulfilled."[2] Or consider the case of neuroaesthetics. This new branch of empirical aesthetics is often defined as the study of the neural processes underlying aesthetic experience. In other words, the job of neuroaestheticians is to discover where and how the different components of our aesthetic responses are implemented in the brain. If this is all we can expect from neuroaesthetics (or aesthetic science in general), then perhaps there is cause for skepticism about the utility of empirical aesthetics to researchers in the humanities. But is this all it has to offer?

Jerry Fodor once made the following remark about the idea that neuroscience, and functional neuroimaging data in particular, might help us understand how the mind works:

> It isn't, after all, seriously in doubt that talking (or riding a bicycle, or building a bridge) depends on things that go on in the brain somewhere or other. If the mind happens in space at all, it happens somewhere north of the neck. What exactly turns on knowing how far north? It belongs to understanding how the engine in your auto works that the functioning of its carburetor is to aerate the petrol; that's part of the story about how the engine's parts contribute to its running right. But why (unless you're thinking of having it taken out) does it matter where in the engine the carburetor is? What part of how your engine works have you failed to understand if you don't know that?[3]

What, indeed, has a philosopher or an art critic failed to understand about our aesthetic appreciation of a Picasso if she doesn't know, for example, that the colors and shapes on the canvas are processed in distinct areas of the brain? Of course, there are many things about our aesthetic responses to artworks that philosophers and art critics still don't understand. However, knowledge of where and how some specific elements of our aesthetic responses are implemented in the brain is unlikely to give us a fuller understanding of what these responses actually are.

This kind of reasoning, however, misrepresents the goal of neuroscientific research, and not just in the case of neuroaesthetics, but cognitive neuroscience in general. It is certainly true that a great deal of research in cognitive neuroscience is concerned with the mapping of perceptual and cognitive functions in the brain, but it would be a mistake to see this as the primary goal of this research.

Part of the problem has to do with the way neuroimaging findings are reported, especially in the media. Major newspapers and popular scientific publications often report that scientists have identified the